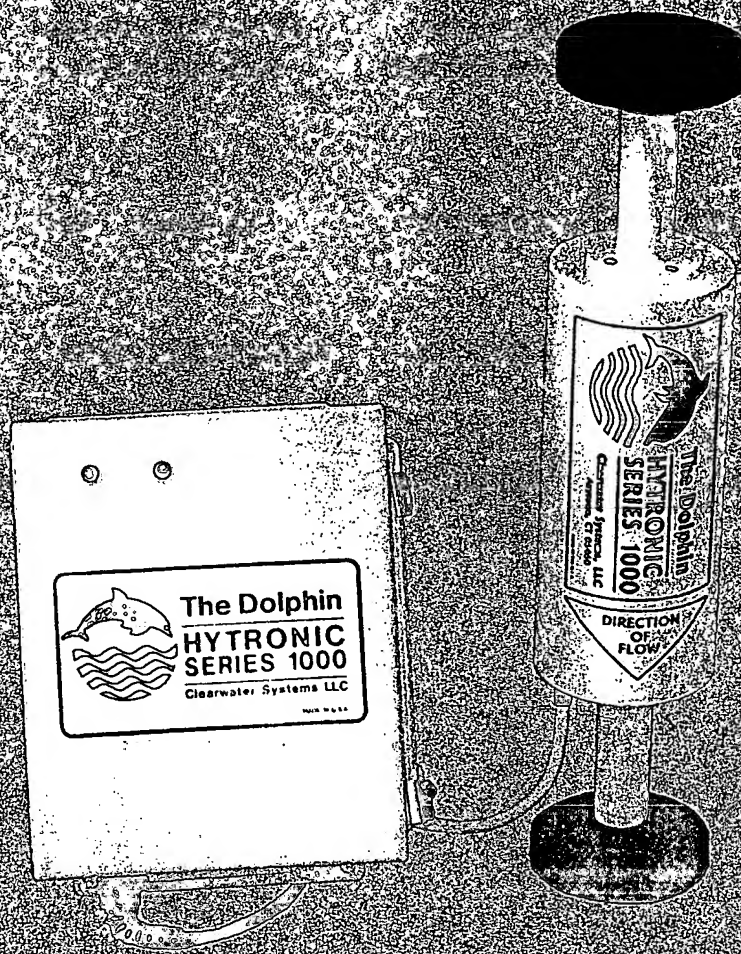


Clearwater Technical Manual

Operation, Installation, and Maintenance on

The Dolphin HYTRONIC SERIES 1000



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List of Current Changes

Original Copy: March 1999

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Change No.	Issue Date	Date Inserted	By	Change No.	Issue Date	Date Inserted	By

List of Ongoing Appendixes or Addenda

New information may be issued in the form of an appendix or as an addendum to your manual. Please store such items with your acknowledgment of receiving them in the following table.

Appendix/Addendum Designation and Title	Issue Date	Date Received	Acknowledged By

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1.0 Introduction

The Dolphin HYTRONIC Series 1000 (Dolphin System) equipment has been designed for ease of installation, minimal maintenance, longevity, and low-cost operation. Please take a few minutes to read the basic instructions and warnings in this manual before attempting any installation of the Dolphin System. If you have any questions about any aspect of installing the system, please call our service center through any of the means listed on the cover of this manual.

1.1 The Dolphin HYTRONIC Series 1000 System

The Dolphin System comprises two main components: the **Transformer Panel** and the **Coil and Pipe Assembly**. The Transformer Panel consists of: a special transformer; an over-voltage fuse, power status light-emitting diodes (LEDs); locking-power cable connector; a power line cord; and fan (if so equipped). The coil and pipe assembly consists of: either a PVC or stainless steel, unobstructed replacement section of pipe; special coils and circuitry; a thermal safety switch with automatic reset; and an interconnecting cable assembly.

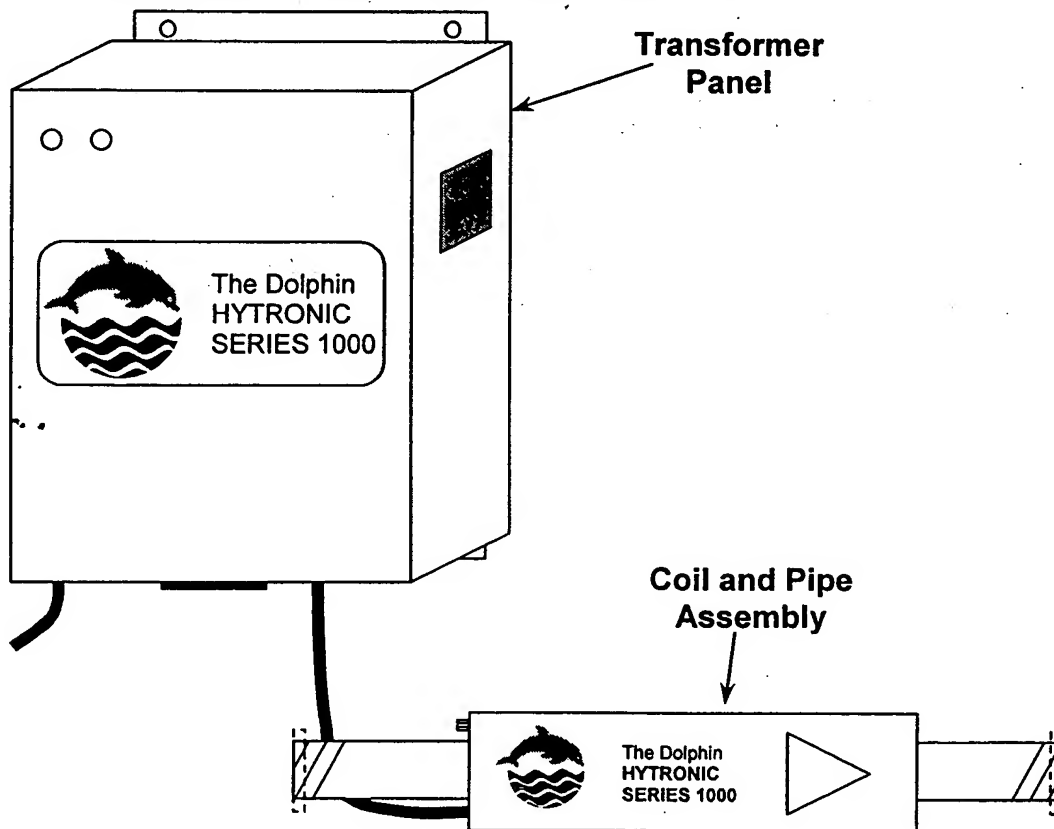


Figure 1. Overview: The Dolphin HYTRONIC Series 1000 System

2.0 Principles of Operation

The Dolphin System is a low-voltage, electrical instrument designed to eliminate problems typically associated with hard water and natural scale-forming precipitates of calcium carbonate (CaCO_3) and other mineral salts that commonly occur in water systems. The Dolphin System changes CaCO_3 and other incorporated minerals from precipitating as the "surface-coating" scale (called calcite) to "free-floating" particles (called aragonite). The aragonite is: non-insulating with respect to heat transfer; non-blockage forming in restricted areas; and low in quantity. These microscopic particles will eventually become large enough to see with the naked eye and then sink rather than float. The aragonite particles exit the system harmlessly in blowdown, filtration, or annual cleaning of the Dolphin System.

2.1 Boiler Operations

With a Dolphin System protected boiler, no new adherent scale will be deposited. The preexisting calcite scale will typically develop hairline cracks and fractures because of ongoing daily thermal expansions and contractions. Normally, these cracks would be repaired by new calcite deposits. However, with the Dolphin System in operation, these cracks are no longer capable of repairing themselves. The hairline cracks continue to grow in size until the preexisting calcite scale detaches and exits the system through normal blowdown and cleaning of the boiler. The initiation of this de-scaling typically begins within three-to-six months of Dolphin System installation.

- **Key Parameters.** In a Dolphin System protected boiler, pH and total dissolved solids (TDS) are the key parameters that help ensure good boiler operations, with pH usually the more critical. Conductivity is an alternative measurement to TDS. The conductivity in micro-siemens per centimeter is equal to about 1.5-to-2.0 times the TDS in parts per million (ppm), depending on the particular make-up of the water.

- **Blowdown Schedule.** The blowdown schedule is used to maintain the proper pH and TDS in the boiler. The boiler pH should be maintained between 9.0 and 11.0. (10.5 is preferred). For most systems, the TDS can settle where it will, usually in the 1500-to-3500 ppm range. If carryover of TDS is of particular concern, follow the manufacturer's recommendations and adjust blowdowns accordingly. The pH of condensate return will typically run between 7.0 and 8.5.

- **Residual Impact.** After the Dolphin System has been in operation for a while, aragonite and flakes of preexisting calcite will appear in the blowdown water. Internal wetted surfaces and exposed metal surfaces will form an adherent and protective layer of magnetite. The magnetite will appear as a dark-reddish, almost black color on the steel or iron. The aragonite particles may also settle in low velocity areas, where they can be easily removed during periodic inspection and/or cleaning. Water softening, which basically replaces Ca^{++} ions with two Na^+ ions, is not necessary nor desirable with a Dolphin System protected boiler.

2.2 Cooling Tower Operations

With a Dolphin System protected cooling tower, no new adherent scale will be deposited. The dissolved CaCO_3 will precipitate as free-floating, microscopic particles of aragonite. As these aragonite particles grow, they will incorporate the vast majority—of all species present—of microscopic life. This particle-incorporating principle is the way in which the Dolphin System keeps the population of bacteria and other microbes exceedingly low.

- **Key Parameters.** In a cooling tower, pH, total dissolved solids (TDS), and Total Bacteria Count (TBC) are the key parameters. Conductivity is an alternative measurement to TDS. The conductivity in micro-siemens per centimeter is equal to about 1.5-to-2.0 times the TDS in ppm, depending on the particular make-up of the water. Clearwater Systems LLC recommends that the pH be maintained at 8.5 for towers with galvanized steel and 9.0 for towers without galvanized steel, but the cooling tower manufacturer's recommendations should be followed. These parameters are adjusted by balancing blowdowns and replacing the recirculating system water with fresh make-up water.

NOTE: The make-up water must have some hardness. Distilled or de-ionized water hamper the Dolphin System's effectiveness, since the bacteria are controlled by the precipitation of the non-adherent aragonite particles. Likewise, water softening, which basically replaces Ca^{++} ions with two Na^+ ions, is not necessary nor even desirable with a Dolphin System.

- **Residual Impact.** A typical cooling tower protected with a Dolphin System will have a pH of 8.5 and operate at 6-to-8 cycles of concentration. The TDS will run in the range of 1000-to-3000 ppm. With these parameters, the TBC will fall within the 2000-to-9999 colony forming units per milliliter (CFU/ml) range. There will be no odor from the tower, and only a slight amount of algae may form on areas intermittently wetted by spray. The water will be clear with little biological debris, and no calcite scale will form.

2.3 Periodic Monitoring

Clearwater Systems LLC strongly recommends that a regime of periodic monitoring be established and maintained. Boilers should be monitored daily, and cooling towers should be monitored weekly. This monitoring should include measuring of pH and TDS (or conductivity). For cooling towers, periodic monitoring of TBC should also be performed.

2.4 Periodic Maintenance

Boilers and cooling towers should be inspected and cleaned as recommended by the manufacturer, or at least on an annual basis. Operators of boilers and cooling towers find that cleaning is much easier after the Dolphin System has been installed, particularly when performed on a periodic basis.

2.5 Start-Up

In addition to the monitoring usually performed on the cooling tower or boiler, Clearwater Systems LLC recommends that additional analyses be performed immediately after the installation of a Dolphin System.

• **Transition to Chemical-Free Water (Cooling Towers).** There may be one or more basic conditions wherein certain procedures are required to transition cooling towers to chemical-free water use. These conditions are described in paragraphs A through C, as follows.

- A. System Totally Drained. The preferred method of transition between chemical control and Dolphin System control is to drain the system totally, clean the system with pressure wash or chemical flush, and recharge it with fresh chemical-free water ready for Dolphin System control.
- B. System Not Drained. When the Dolphin System cannot be drained conveniently (e.g., in a high rise), the system may be started with the chemicals present after system control has begun. However, the following steps should be taken:
 1. Stop all new chemical additions.
 2. Operate with the blowdown substantially and continuously open for a scheduled period of time (as suggested by Clearwater Systems LLC, based on the volume of the system). This activity will have the effect of changing the chemical-containing water gradually over a few days of operation without disruption.
- C. Dolphin Installation on One Cooling Cell or Chiller Circuit at a Time. When continuous operation or other reasons dictate that one cell or chiller must be shut down for Dolphin System installation while the others run, the waters are usually commingled after restart and thus contain chemicals. In such cases, until all cells or chiller circuits have been converted to Dolphin System control, operate the system under the existing chemical regime. When the installation is complete and all the required Dolphin units are operating, follow the method in the above paragraph (System Not Drained) for transition to chemical-free water.

• **Transition to Chemical Free-Water (Boilers).** Draining boilers is not required. Normal blowdown will gradually introduce Dolphin System-treated water to boilers.

• **Balancing Water System Parameters With Blowdown.** Clearwater Systems LLC suggests that pH is the most important parameter to control within boilers and cooling towers. Therefore, it is recommended that a blowdown protocol be determined to stabilize pH values as follows:

- Boilers: pH 10.5
- Cooling Towers without galvanized steel: pH 9.0
- Cooling Towers with galvanized steel: pH 8.5

Following these pH values will give optimum performance. To stabilize at these values, the following steps should be taken:

1. Install and activate the Dolphin System.

2. Initially use the blowdown schedule or conductivity setting that the operator has used in the past.
3. After one week of operation, check pH against the appropriate values.
4. Adjust blowdown by increasing it to lower pH, or decreasing it to raise pH.
5. After one week of operation, check pH against the target value. If it is not attained, repeat steps 4 and 5 (if still not attained, repeat steps 4 and 5 as many times as necessary).
6. Once the pH is stabilized at the desired value, record the conductivity setting on the automatic blowdown, or on the manual blowdown schedule with respect to frequency and duration. The recorded settings should be the basis for continuing the blowdown procedure.

The above procedure should result in approximately the following values:

- Total Dissolved Solids (TDS) of about 2000 ppm.
- Conductivity of about 3500 $\mu\text{S}/\text{cm}$.
- Cycles of Concentration of about 6-to-8 (i.e., the ratio of conductivity of blowdown divided by the conductivity of makeup).
- Total Bacteria Count (TBC) of less than 10,000 CFU/ml

If any of these values are unacceptable to the operator, balance the blowdown to achieve the desired parameter values. In all cases, scale will be eliminated and microbes controlled without chemical addition. The only compromises may be slightly reduced water savings and slightly increased corrosion of mild steel in the system (yet fully within design constraints).

• **Periodic Inspections.** During the first 90 days after installation, Clearwater Systems LLC recommends that at least four inspections of the system be performed. Weeks 2, 4, 8, and 12 are suggested. At each of these points, verify that:

1. The system blowdowns are working properly.
2. The power and signal LEDs on the Dolphin System are illuminated.
3. The system chemistries are within the expected range or heading toward the expected range.
4. The ventilation ports on both the Transformer Panel and the Coil and Pipe Assembly are free of obstructions.

In addition to these four inspections, monitor the boiler water chemistry daily, and cooling tower water chemistry weekly as described in section 2.3.

2.6 Operating Temperatures and Pressures for the Dolphin System

The recommended ambient operating temperatures are 0°F to 123°F.

The maximum fluid operating pressures and temperature de-rating factors for the Dolphin System are listed in the following two tables.

Table 1. Maximum Fluid Operating Pressur

Pipe Diameter	Max. pressure at 73° F*	
	PVC	Stainless
3/4"	690 psi	1700 psi
1"	630 psi	1900 psi
2"	400 psi	1400 psi
3"	370 psi	1200 psi
4"	320 psi	900 psi
6"	280 psi	700 psi
8"	250 psi	600 psi
10"	230 psi	500 psi
12"	230 psi	500 psi

* Rated pressures based on pipe. Consideration must also be given to rated capacity of flange (if applicable).

Table 2. Temperature De-Rating Factor for PVC

Temp. degrees F°	De-rating Factor PVC
73	1.00
80	0.88
90	0.75
100	0.62
110	0.51
120	0.40
130	0.31
140	0.22

NOTE: These are typical values. Check with a plumbing contractor for a particular application.

3.0 Service and Warranty

3.1 Service

Clearwater Systems LLC has made quality an uncompromising standard in its design and production of the DOLPHIN HYTRONIC SERIES 1000 water treatment systems. The Dolphin System was designed and built to ISO 9000 standards in a modern U.S. facility with only premium materials being used in its construction. The electronics are totally solid state and should provide years of trouble-free operation. However, as with any electronic device, problems can occur. In the unlikely event that Dolphin System service is required, it is very important that it be provided by only factory trained and authorized technicians who are familiar with this unique technology and have access to factory-authorized parts. Any attempts to repair Dolphin System equipment by unauthorized individuals or with unauthorized parts can void your warranty. We strongly advise you to contact your local Clearwater Systems LLC authorized representative or one of our Clearwater Systems LLC technical sales engineers.

3.2 Warranty

LIMITED ONE-YEAR WARRANTY

Clearwater Systems LLC (Clearwater) warrants that the products it manufactures will be free from defects in materials and workmanship. The warranty term is one year, beginning on the date of installation, as described herein.

This warranty shall not apply and does not cover damage due to external causes, including accident, abuse tampering, misuse, electrical overload, servicing not authorized by Clearwater Systems LLC, usage not in accordance with product instructions, faulty installation, unauthorized product modification, failure to perform required preventive maintenance, and problems caused by use of parts and components not supplied by Clearwater.

During the one-year period beginning on date of installation, Clearwater Systems LLC will repair or replace products covered under this limited warranty that, at Clearwater's option, either are returned to Clearwater's facility or repaired on-site by authorized Clearwater personnel or agents. To request warranty service, the purchaser must call Clearwater's customer Technical Support within the warranty period. If warranty service is required and repair is to be accomplished at a Clearwater facility, Clearwater will issue a Return Material Authorization Number. The purchaser must ship the products back to Clearwater in their original or equivalent packaging, prepay shipping charges, and insure the shipment or accept the risk of loss or damage during shipment. Clearwater will ship the repaired or replacement products to the purchaser freight prepaid if the purchaser uses an address in the continental United States. Shipments to other locations will be made freight collect.

Clearwater owns all parts removed from repaired products. If Clearwater repairs or replaces a product, its warranty term is not extended.

NOTE: CLEARWATER MAKES NO EXPRESSED WARRANTIES BEYOND THOSE STATED IN THIS WARRANTY STATEMENT. CLEARWATER DISCLAIMS ALL OTHER WARRANTIES AND CONDITIONS, EXPRESSED OR IMPLIED, INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. CLEARWATER'S RESPONSIBILITY FOR MALFUNCTIONS AND DEFECTS IN THE PRODUCT IS LIMITED TO REPAIR AND REPLACEMENT, AS SET FORTH IN THIS WARRANTY STATEMENT. THESE WARRANTIES GIVE THE PURCHASER SPECIFIC LEGAL RIGHTS, AND THE PURCHASER MAY ALSO HAVE OTHER RIGHTS, WHICH MAY VARY FROM STATE TO STATE (OR JURISDICTION).

CLEARWATER SYSTEMS LLC DOES NOT ACCEPT: (1) LIABILITY FOR THE PRODUCTS OR THEIR PERFORMANCE BEYOND THE REMEDIES SET FORTH IN THIS WARRANTY STATEMENT, OR (2) LIABILITY FOR ANY SPECIAL, INDIRECT, PUNITIVE, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OF ANY KIND OR CHARACTER, INCLUDING, WITHOUT LIMITATION, LOSS OF REVENUE OR PROFITS, FAILURE TO REALIZE SAVINGS OR OTHER BENEFITS, OR CLAIMS AGAINST PURCHASER BY ANY THIRD PARTY, EVEN IF CLEARWATER SYSTEMS LLC HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

3.3 Legionella Statement

The presence of *legionella* bacteria in a cooling tower system, hot water system, or other water system is a function of local water attributes. The risk of human infection is related to many factors under the control of building management such as system design, temperature, likelihood of aspiration, and others.

- **Bacteria Control.** The Dolphin System controls the population of any bacteria species present in the system. However, the system leaves unaffected a percentage of any bacteria species present in the system. The Dolphin System is not a disinfectant device and does not selectively or uniformly kill bacteria. The system controls bacteria populations by inhibiting bacteria reproduction through physical mechanisms not lethal to bacteria.
- **Building Management Concerns.** Building management concerned about *legionella* should follow local approved guidelines for system design and operation. If *legionella* presence becomes an unacceptable risk due to potential human infection, or levels of *legionella* population are determined by periodic water or air sampling, approved disinfection procedures and corrective action should be followed.
- **Disclaimer.** Clearwater Systems LLC cannot, through the use of its product (the Dolphin System) or through any other means, eliminate the presence of *legionella* in water systems or control the potential risk factors for human infection. Therefore, Clearwater Systems LLC disclaims any responsibility for consequential damages resulting from the presence of *legionella* bacteria in a water system. The Dolphin's System's only microbiological function is the reduction of the population of any species of bacteria present in the system, as measured by standard sampling and analysis procedures for Total Bacteria Count (TBC), reported in measurements of CFU/ml.

4.0 Dolphin System Major Component Descriptions

As depicted on page 1 of this manual in Figure 1, the Dolphin System consists of two main units: the Transformer Panel, and the Coil and Pipe Assembly.

4.1 The Transformer Panel

Depicted in Figure 2, the Transformer Panel contains the transformer, fuse, power and signal status LEDs, locking Coil & Pipe Assembly signal cable connector, power cord and plug assembly, ventilation ports, and a fan (if so equipped). Table 3 below lists the physical specifications for the Transformer Panel.

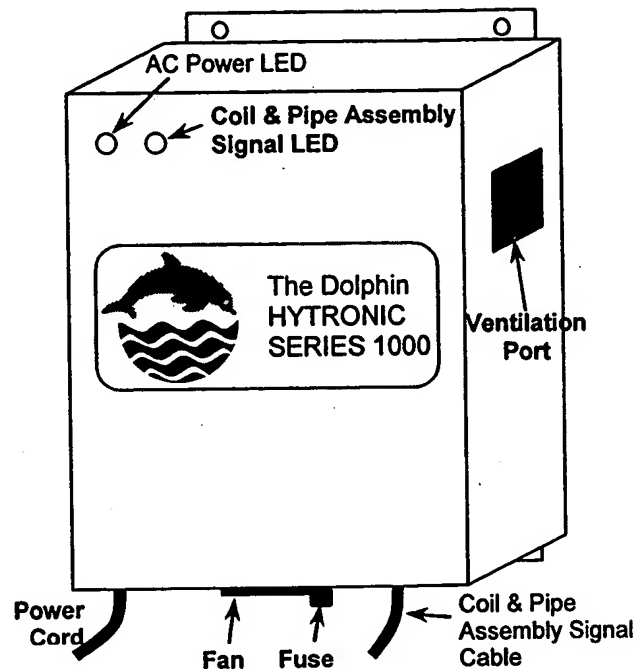


Figure 2. Transformer Panel

Table 3. Transformer Panel Specifications

Model	Pipe Size	Voltage	VA (watts)	Enclosure Dimensions*	Cable	8' Power Cord	Net Weight	
							Coil	Control
1007-S&T	3/4"	120V/60Hz	110	8"W X 10"H X 6" Deep	9.5'	120VAC/15 A plug	6 lb	17 lb
1010-SST	1.0"	120V/60Hz	150	8"W X 10"H X 6" Deep	9.5'	120VAC/15 A plug	11 lb	17 lb
1020-SST	2.0"	120V/60Hz	220	8"W X 10"H X 6" Deep	9.5'	120VAC/15 A plug	27 lb	21 lb
1030-SST	3.0"	120V/60Hz	325	10"W X 10"H X 8" Deep	9.0'	120VAC/15 A plug	35 lb	31 lb
1040-PVC	4.0"	120V/60Hz	390	10"W X 10"H X 8" Deep	9.0'	120VAC/15 A plug	43 lb	31 lb
1060-PVC	6.0"	120V/60Hz	480	10"W X 10"H X 8" Deep	9.0'	120VAC/15 A plug	109 lb	34 lb
1080-PVC	8.0"	220V/60Hz	2400	14"W X 16"H X 8" Deep	9.0'	220VAC/15 A plug	140 lb	65 lb
1100-PVC	10.0"	220V/60Hz	2100	14"W X 16"H X 8" Deep	16.0'	220VAC/15 A plug	175 lb	65 lb
1200-PVC	12.0"	220V/60Hz	1800	14"W X 16"H X 8" Deep	16.0'	220VAC/15 A plug	206 lb	65 lb

* Dimensions subject to change without notice.

4.2 The Coil and Pipe Assembly

Depicted in Figure 3, the Coil and Pipe Assembly consists of a PVC or stainless steel flow-through pipe supplied with NPT-threaded ends or 150 pounds-per-square inch (psi) flanges, coil assembly, internal thermal protection switch with automatic reset, diode and heat sink assembly, power cable, and locking plug connector. Table 4 below lists the physical characteristics for the Coil and Pipe Assembly.

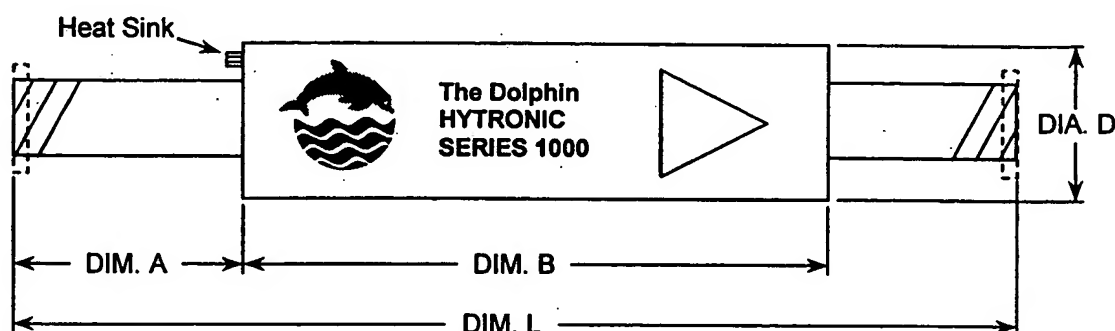


Figure 3. Coil and Pipe Assembly

Table 4. Coil and Pipe Assembly Physical Characteristics

Model	Nominal Pipe Size	Pipe Material	Dim. A	Dim. B	Dia. D	Dim. L	Pipe Fitting
1007-SST	3/4"	T316 SST, Sched. 40	3.25"	10.0"	3.50"	16.5"	3/4" NPT
1010-SST	1.0"	T316 SST, Sched. 40	2.88"	14.0"	4.50"	19.75"	1.0" NPT
1020-SST	2.0"	T316 SST, Sched. 40	10.25"	19.0"	5.56"	39.5"	2.0" NPT
1030-SST	3.0"	T316 SST, Sched. 10	10.25"	19.0"	8.63"	39.5"	150lb SS Flange
1040-PVC	4.0"	PVC, Sched. 80	10.25"	19.0"	8.63"	39.5"	150lb PVC Flange
1060-PVC	6.0"	PVC, Sched. 80	18.25"	23.0"	12.75"	59.5"	150lb PVC Flange
1080-PVC	8.0"	PVC, Sched. 80	15.25"	29.0"	16.0"	59.5"	150lb PVC Flange
1100-PVC	10.0"	PVC, Sched. 80	15.25"	29.0"	16.0"	59.5"	150lb PVC Flang
1200-PVC	12.0"	PVC, Sched. 80	15.25"	29.0"	16.0"	59.5"	150lb PVC Flange

NOTE: Thermal Protection Switch.

- PVC Coil and Pipe Assembly set at 212°F. (See actual temperature limitation in section 2.6.)
- Stainless steel Coil and Pipe Assembly set at 266°F.

5.0 Installation Instructions

WARNING

TO AVOID POSSIBLE DAMAGE TO THE COIL ASSEMBLY, NEVER ATTEMPT TO TIGHTEN THE COIL AND PIPE ASSEMBLY TO THREADED FITTING BY GRIPPING AND ROTATING THE COIL ASSEMBLY. ALL ROTATIONAL FORCE USED TO TIGHTEN INSTALLATION FITTINGS MUST BE APPLIED DIRECTLY TO ONLY THE PIPE OR FITTINGS.

WARNING

THE DOLPHIN SYSTEM MUST BE TURNED OFF OR UNPLUGGED PRIOR TO PERFORMING ANY MAINTENANCE, CLEANING, OR DRAINING OF THE SYSTEM THAT WOULD RESULT IN WATER LEVELS BEING REDUCED TO THE POINT WHERE A DRY PIPE CONDITION WOULD OCCUR IN THE DOLPHIN SYSTEM COIL AND PIPE ASSEMBLY.

5.1 Installation Location of the Coil and Pipe Assembly for Boilers

In general, two Dolphin Systems are required with a boiler. One system is installed on the fresh water make-up line, and an additional system is installed on the boiler feedline. Proper configuration and placement of the Dolphin Systems are critical to their overall performance.

• **Guidelines.** For optimal operation, the Dolphin Systems should be installed according to the following guidelines.

1. The make-up line Dolphin System should be installed after or downstream of the fill control valve on the make-up water line into the condensate return tank. Ideally, the line will fill into a reservoir on the tank below the water line, allowing "aragonite-diffusion continuity" of the Dolphin System to the make-up water tank. (See Figure 4.)
2. The boiler feed line Dolphin System should be installed after or downstream of the feedwater pump and prior to the boiler. (See Figure 4.)

NOTE: It is critical that no pumps be installed immediately downstream of the Dolphin System, since extreme turbulence could break up the aragonite.

3. The Dolphin Systems should have water in their pipes at all times.
4. The Dolphin Systems must be at least three feet away from any motors, pumps, another Dolphin System, or any other high voltage energy source.
5. The Dolphin Systems should be downstream from any extreme turbulence.
6. The location for the Coil and Pipe Assembly and the Transformer Panel must be dry and provide adequate protection against rain, snow, and other inclement weather conditions. For outdoor installation of the Coil and Pipe Assembly, see paragraph 5.3.
7. The flow must be in the direction indicated on the Coil and Pipe Assembly.

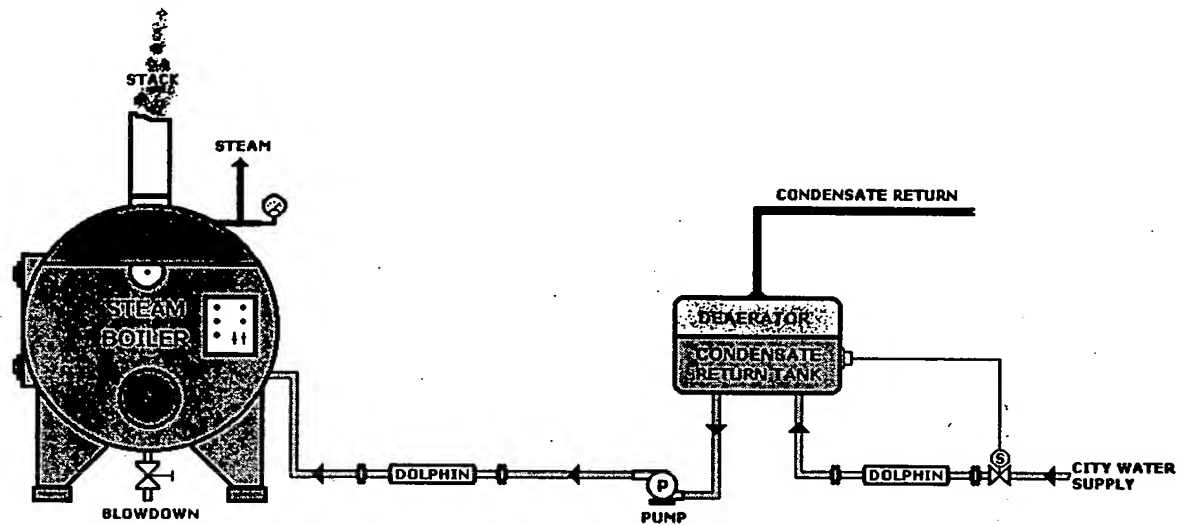


Figure 4. Typical Boiler Installation

5.2 Installation Location of the Coil and Pipe Assembly for Cooling Towers

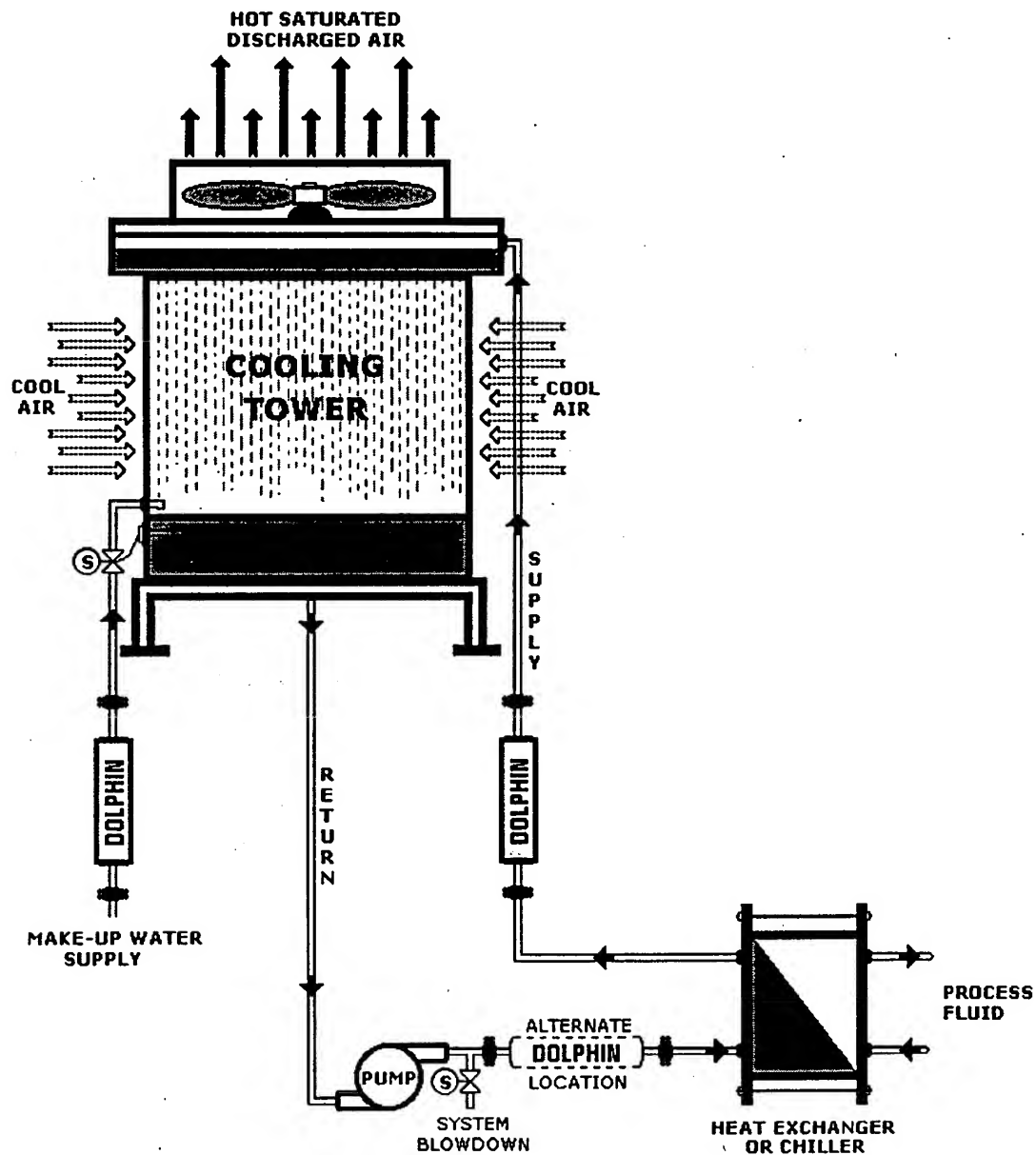
In general, two Dolphin Systems are required with a cooling tower. One system is installed on the fresh water make-up line, and an additional system is installed on the recirculating line. Proper configuration and placement of the Dolphin Systems are critical to their overall performance.

• **Guidelines.** For optimal operation, the Dolphin Systems should be installed according to the following guidelines.

1. The make-up line Dolphin System should be installed at a convenient point prior to combining with recirculating water.
2. The recirculating system should be installed after or downstream of all pumps and prior to the cooling tower. (See Figure 5.) An equally acceptable alternative is to install the recirculating system prior to the heat exchanger but after all pumps.

NOTE: It is critical that no pumps be installed immediately downstream of the Dolphin System, since extreme turbulence could break up the aragonite.

3. The Dolphin Systems should have water in their pipes at all times.
4. The Dolphin Systems must be at least three feet away from any motors, pumps, another Dolphin System, or any other high voltage energy source.
5. The Dolphin Systems should be downstream from any xtreme turbulence.
6. The location for the Coil and Pipe Assembly and the Transformer Panel must be dry and provide adequate protection against rain, snow, and other inclement weather conditions. For outdoor installation of the Coil and Pipe Assembly, see paragraph 5.3.
7. The flow must be in the direction indicated on the Coil and Pipe Assembly.



Figur 5. Typical Evaporative Cooling Tower Installation

5.3 Outdoor Installation of the Coil and Pipe Assembly

Before installing the Coil & Pipe Assembly outdoors, contact your local Clearwater Systems LLC authorized installation representative or technical sales engineer for assistance in the proper protection and location of the Coil and Pipe Assembly. For an outdoor installation, a simple rain cover is all that is necessary to protect the components.

5.4 Installation of the Transformer Panel

The Transformer Panel can be easily mounted on any flat surface using the external flanges or tabs provided and four mounting screws. The unit is provided with an 8-foot power cord and plug assembly. Please be sure that adequate electrical service is located within six (6) feet of the Transformer Panel. Check the electrical system to make sure there is correct voltage and amperage prior to plugging in the Dolphin System.

• **Installation Advice.** The Transformer Panel should be mounted at eye level in an accessible area that allows for easy observation of power and signal status LEDs during normal daily operations. Ensure that all unit ventilation ports are clear of obstructions. The location chosen should be dry and provide adequate protection against rain, snow, and other inclement weather conditions. If the unit is to be installed outdoors, please contact a Clearwater Systems LLC representative for more information concerning this type of installation.

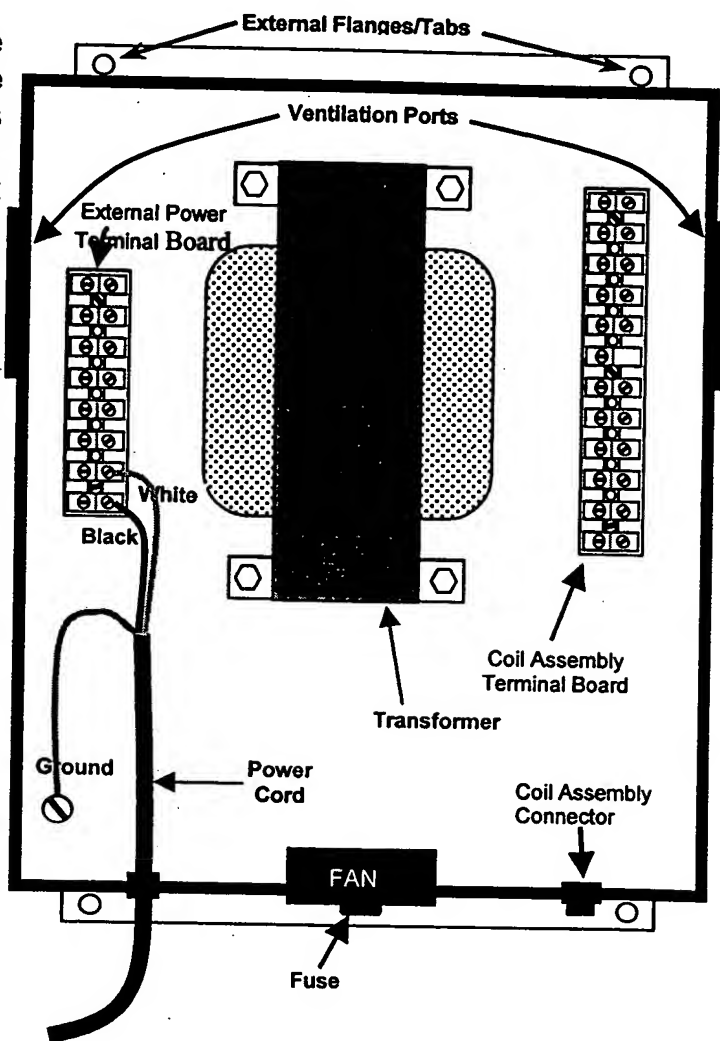


Figure 6. Transformer Panel Call-Out

NOTE: The transformer panel must not be installed within three (3) feet of a high voltage source such as motors, pumps, or electronic switching equipment.

6.0 T sting and Troubleshooting

Before calling for service, please review the troubleshooting chart below for potential operating problems and related solutions. If the problem persists or is intermittent, please call your authorized sales representative or Clearwater Systems LLC directly.

Table 5. Troubleshooting Chart

PROBLEM	POSSIBLE CAUSE	SOLUTION
The Dolphin System will not turn on.	Power cord not firmly plugged into a grounded AC wall outlet. Wrong wall outlet voltage. A tripped circuit breaker for the wall outlet. Fuse located on bottom of Transformer Panel is loose, missing, or blown.	Reinsert the wall plug. Confirm that the wall outlet voltage matches the voltage requirements of the Dolphin System. Check the wall outlet circuit breaker; reset if necessary. Check fuse on bottom of the Power Transformer Panel; replace if necessary.
Two power status LEDs fail to light.	See causes above.	See solutions above.
One power status LED fails to light.	Coil and Pipe Assembly cable not firmly plugged into Power Panel. Coil and Pipe Assembly cable not firmly connected. LED failure or open diode.	Reinsert the Coil and Pipe Assembly cable plug into the connector located on the bottom of the Transformer Panel. Make certain that the plug locks in position. Check serial numbers located on the Transformer Panel and the Coil and Pipe Assembly to make sure they agree. Call for service.
One LED blinks or is intermittent.	Coil and Pipe Assembly are approaching maximum operating temperature, causing the thermal safety switch to open and close. Loose Coil and Pipe Assembly cable connector.	Reduce the operating temperature of water flowing through the Coil and Pipe Assembly. Reinsert the Coil and Pipe Assembly cable plug into the connector located on the bottom of the Transformer Panel. Make certain that the plug locks in position.
One LED turns off and remains off during operation.	Maximum operating temperature of the water flowing through the Coil and Pipe Assembly has been exceeded. Thermal Safety Switch has opened. LED failure or open diode.	Reduce the operating temperature of water flowing through the Coil and Pipe Assembly. The Thermal Safety Switch will automatically reset. Call for service.
Blown Fuse.	Defective or weak fuse. Power surge. Dolphin System has exceeded its electrical design parameters. Lightening strikes on related equipment. Voltage or polarity of wall outlet is incorrect. Water has entered the electronics. Pinch d wire or cable. Short circuit in transformer or coils.	Replace the fuse and attempt restart of the Dolphin System. Check outlet for proper voltage, ground, load, and neutral. Contact your local sales representative or Clearwater Systems LLC directly.

7.0 Routine Maintenance

WARNING

THE DOLPHIN SYSTEM MUST BE TURNED OFF OR UNPLUGGED PRIOR TO OPENING THE TRANSFORMER PANEL DOOR, PERFORMING ANY MAINTENANCE, OR CLEANING THE CABLES AND CONNECTORS.

The Dolphin System requires no routine maintenance other than occasional inspections of cables and connectors, the Coil Assembly, and Transformer Panel.

WARNING

THE DOLPHIN SYSTEM MUST BE TURNED OFF OR UNPLUGGED PRIOR TO PERFORMING ANY MAINTENANCE, CLEANING, OR DRAINING OF THE SYSTEM THAT WOULD RESULT IN WATER LEVELS BEING REDUCED TO THE POINT WHERE A DRY PIPE CONDITION WOULD OCCUR IN THE DOLPHIN COIL AND PIPE ASSEMBLY.

NOTE: Check the cooling vents and fan (if so equipped) periodically to help ensure proper air flow. Remove all foreign matter that might inhibit proper air flow through the Dolphin System. Clean the Transformer Panel filters and the Coil and Pipe Assembly cooling holes.

7.1 Inspection

WARNING

ELECTRICAL SHOCK HAZARD

POWER TO THE DOLPHIN SYSTEM MUST BE DISCONNECTED OR TURNED OFF PRIOR TO OPENING THE TRANSFORMER PANEL DOOR, PERFORMING ANY MAINTENANCE, OR CLEANING THE CABLES AND CONNECTORS.

• **Inspection Procedures.** Inspection procedures for the Dolphin System pertain chiefly to inspecting cables and connectors, the Coil Assembly, and the Transformer Panel.

1. Inspect the power cable for visible damage that might affect the safety and operation. This visible inspection should ensure that no wires have been cut or are exposed.
2. Inspect the Coil Assembly cable for visible damage that might affect the safety and operation of the Dolphin System. This visible inspection should ensure that no wires have been cut or are exposed.
3. Inspect the Coil Assembly connector for corroded or damaged pins.
4. Inspect the Transformer Panel to ensure that it is firmly secure as mounted.

7.2 Cleaning

The Dolphin System should be virtually maintenance free. If for any reason the outward surface of the Transformer Panel requires cleaning, clean the outside surface with a damp clean cloth. Wipe clean with a soft cloth. Let air dry.

8.0 Preparation for Shipment

• **Reshipping Procedures.** In the unlikely event that you need to return the Dolphin System for repairs, the following reshipping procedures apply as guidelines for best commercial practices.

1. Install plastic dust caps, or equivalent, on any connectors/receptacles on the Transformer Panel and Coil Assembly.
2. Wrap the Transformer Panel and Coil Assembly in barrier material, or equivalent, and secure with premium quality duct tape or equivalent.
3. Pad projections, sharp edges, or other features of the units which may damage the package with cellulose cushioning material or equivalent.
4. Use a sturdy cardboard box capable of handling the weight of the Dolphin System.
5. Secure all seams with high quality packaging tape.
6. Address package to:
Clearwater Systems LLC
145 Dennison Road
P.O. Box 463
Essex, CT 06426
7. Be sure to include your return mailing address on the shipping label.

9.0 Optional Equipment

9.1 Building Management Systems (Remote Interface)

Optional equipment for use with the Dolphin System pertains to 1000RI remote indicators for building management systems. Two types of remote indicators are currently available, as follows.

1. **Series 1000RIA.** This remote indicator provides dry FORM A contact to building management systems. (Relay contacts are closed during no-fault operations.)
2. **Series 1000RIB.** This remote indicator provides dry FORM B contact to building management systems. (Relay contacts are opened during no-fault operations.)
 - Relay Contact Rating (maximum): 10VA RES. (load)
 - Switching Current (maximum): 0.5A
 - Contact Resistance: 0.2 ohms

9.2 Outside Installation

Optional equipment for outside installation of the Dolphin System may include the following items.

1. Horizontal shrouds for the Dolphin System Coil and Pipe Assembly.
2. Vertical shrouds for the Dolphin System Coil and Pipe Assembly.
3. NEMA 3R enclosure.

Appendix A: Maintenance Schedules

Tabl A-1. Dolphin-Equipped Cooling Tower Maintenance Schedule

Action	Person Responsible	Date Performed	Frequency
Dolphin Equipment			
Check LED indicators to ensure that the system is on and operating properly.			Frequently (Daily)
Check Transformer Panel ventilation filters and clean, if required.			Quarterly
Check fan screens, louvers, and fans. Remove all dirt and debris.			Quarterly
Visually inspect all wetted tower components for mineral deposit, algae, corrosion, discoloration of water, or odors associated with biological contamination.			Weekly or at Least Quarterly
Blowdown System			
Check water in system for proper pH and TDS (total dissolved solids).			Weekly or at Least Quarterly
Perform blowdowns of system to maintain proper pH and TDS .			As Required if Manual
If equipped, check automatic blowdown system to make sure it is operative.			Quarterly
If equipped, clean all sensors and probes associated with the automatic blowdown system.			Quarterly
If equipped, check bleed-valve to make sure it is operative.			Quarterly
Calibrate automatic blowdown system: pH probe or conductivity probe.			Quarterly
General Good Practices			
Clean entire system annually .			Annually
Inspect and clean protective finish of the tower. Paint if necessary with appropriate rust-inhibiting paint per manufacturer's instructions.			Annually
After extended shutdown periods, clean all debris from the system, including: tower, pan, system piping, heat exchanger, and remote sump holding tanks. Drain systems and refill with fresh clean water.			Extended Shut Downs

If you have any questions, please contact
Clearwater Systems LLC
145 Dennison Road
P.O. Box 463
Essex, CT 06426

Phone: 860-767-0850 • Toll Free: 888-500-5757 • Fax 860-767-8972
Email: cws@clearwater-dolphin.com

Tabl A-2. Dolphin-Equipped Boiler Maintenance Schedule

Action	Person Responsible	Date Performed	Frequency
Dolphin Equipment			
Check LED indicators to ensure that the system is on and operating properly.			Frequently (Daily)
Check Transformer Panel ventilation filters and clean, if required.			Quarterly
Check fan screens, louvers, and fans. Remove all dirt and debris.			Quarterly
Blowdown System			
Check water in system for proper pH and TDS (total dissolved solids).			Weekly or at Least Quarterly
Perform blowdowns of system to maintain proper pH and TDS.			As Required if Manual
If equipped, check automatic blowdown system to make sure it is operative.			Quarterly
If equipped, clean all sensors and probes associated with the automatic blowdown system.			Quarterly
Calibrate automatic blowdown system: pH probe or conductivity probe.			Quarterly

If you have any questions, please contact

Clearwater Systems LLC

145 Dennison Road

P.O. Box 463

Essex, CT 06426

Phone: 860-767-0850 • Toll Free: 888-500-5757 • Fax 860-767-8972

Email: cws@clearwater-dolphin.com

Appendix B: Glossary of Terms

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GLOSSARY OF TERMS

aragonite: a naturally occurring form of calcium carbonate (CaCO_3) induced by the Dolphin System; aragonite is similar to calcite but differs in density and crystalline structure.

aragonite diffusion continuity: the process by which the Dolphin System continually treats water—that is, by means of an unbroken channel of water through the piping system.

blowdown: the removal of concentrated water for the purpose of controlling the total solids concentration in the remaining water.

calcite: a naturally occurring form of calcium carbonate (CaCO_3) which produces a very hard scale when introduced to heat transfer surfaces. In crystalline form, calcite can also include limestone, chalk, and marble.

CFU/ml: colony-forming units per milliliter; used to measure total bacterial count (TBC).

calcium carbonate: a compound (CaCO_3) found in nature as calcite and aragonite; commonly found in plant ashes, bones, and shells. Calcium carbonate is used in making lime and portland cement.

condensate return tank: a collection tank for process steam which has been condensed to water and is to be returned to the system.

conductivity: the transfer of thermal or electrical energy along a potential gradient. This principle is used to determine the quantity of ions in a water sample.

cooling tower: a structure used to cool water by exposing it to ambient air. Typically, water enters the top of the tower and flows over a series of cascading plates or screens while air is drawn through the structure with fans.

de-ionized water: water which is free of positively or negatively charge atoms.

feedwater: the water that enters a boiler during operation. It includes make-up water and condensate from the condensate return tank.

hard water: water that contains scale-forming impurities. The magnitude of water hardness is dependent upon the concentration of dissolved calcium and/or magnesium compounds.

ion: an atom or group of atoms that carries a positive or negative charge as the result of having lost (positive charge) or gained (negative charge) one or more electrons.

magnetite: iron oxide (Fe_3O_4), also known as magnetic oxide; created by the reaction of pure water and iron under some specific conditions.

mak -up water: water which must be added to the system to replace water which has evaporated, gone to drain, lost, etc.

GLOSSARY OF TERMS (continued)

microbe: a microorganism or germ.

NEMA 3R: National Electrical Manufacturers Association enclosure designation 3R, which is intended for outdoor use primarily to provide a degree of protection against rain, sleet, and damage from external ice formation.

NPT-threaded: National Pipe Taper, part of the American National Standard for Pipe Threads; designates a thread diameter taper of 1/16" per inch of thread length. NPS designates National Pipe Straight (no taper).

pH: a scale whose values range from 0 to 14, with 7 representing neutral, numbers less than 7 increasing acidity, and numbers greater than 7 increasing alkalinity. Derived from the negative logarithm of the effective hydrogen ion activity in gram equivalents per liter.

ppm: parts per million, used as a volumetric measurement of very small quantities.

precipitate: a solid substance separated from a solution or suspension by chemical or physical change.

PVC: polyvinyl chloride; used for plastic pipe.

remote indicators: auxiliary equipment for the Dolphin System; used to monitor system operation from remote locations.

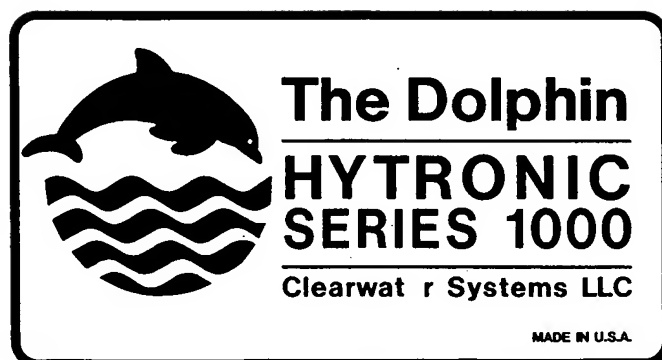
scale: solid deposits heat transfer surfaces caused by impurities in hard water.

shrouds: protective covers used to minimize the exposure of the Dolphin System to weather elements.

TBC: total bacteria count, typically measured in colony forming units per milliliter (CFU/ml).

TDS: total dissolved solids, typically measured in parts per million (ppm).

transformer: an electromagnetic device that converts variations of voltage and current in a primary circuit into variations of voltage and current in a secondary circuit.



145 Dennison Road P.O. Box 463 Essex, CT 06426

